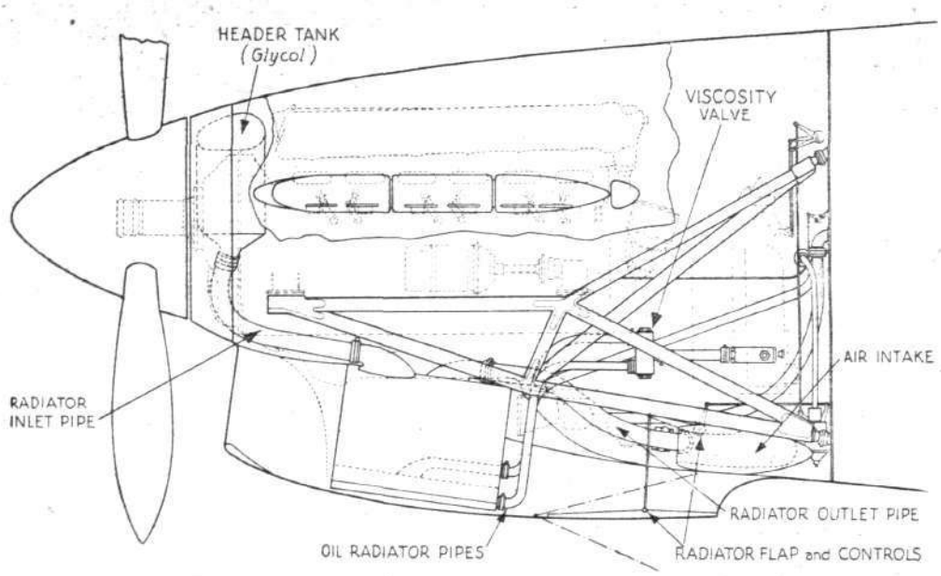


A self-explanatory drawing of a hypothetical Merlin installation showing possibilities in the placing of the various units.

Up to the present we have seen no British-designed small-diameter two-row radial in the 650-800 h.p. class as typified by the Gnome Rhone M.14 (this design forms the basis for the Alvis Maeonides Major) and the Hispano Suiza 14 AB. Such engines may be useful for installation in the fast twin-engined fighters which seem to be coming into vogue, although there is a strong feeling in some quarters that much more power will be required to achieve the desired performance.

As "hybrid" types between the two-row radial and the "H" or "X" shaped engine we are likely to see multi-bank, multi-row units as foreshadowed by this double-octagon Bristol.

Mr. Fedden, in his last paper before the Royal Aeronautical Society, mentioned a projected twenty-cylinder, five-bank radial of 1,005 cu. in. capacity, 40in. diameter, 1,450 lb. weight and 1,000 h.p. output at 13,000ft., which may be taken as a forecast of one line of approach to the problem of taking high power from relatively small bulk.

The air-cooled engine of "H" formation has so far been developed exclusively in this country, although the American Ranger concern is known to be working along similar lines to the Napier Company with a twenty-four-cylinder unit. Whereas Fairchilds are still very much in the experimental stage we, in this country, already have "H" engines in regular service. The twenty-four cylinder Dagger III is the power plant of the Hawker Hector army co-operation biplane, and the sixteen-cylinder Rapier is installed in the Fairey Seafox light reconnaissance floatplane and in *Mercury*, the high-speed Transatlantic upper component of the Short-Mayo composite aircraft. Essential characteristics of such engines are the high r.p.m. (about 4,000) and the extremely good outputs per unit volume. It is known that a good deal more power than the 805 h.p. of the Dagger III is being taken from the E.108 engine of similar capacity (16.8 litres) so we may form some idea of the potentialities of this type of power plant. It is not to be expected that the specific weight, on the high side at present, will increase in proportion.

"Cannon" Possibilities

An incidental advantage of the "H" layout, apart from small frontal area (although the wetted surface is not impressively low) is the possibility of fitting a "cannon" to fire through the airscrew shaft. This quality—of somewhat doubtful worth—is, of course, also inherent in the inverted "V" and the "X" layouts, but not in radials.

For powers of 400-700 h.p. the inverted vee-twelve air-cooled unit seems destined for quite a useful future. Great Britain's offering in this class is the D.H. Gipsy Twelve, or Gipsyking, of 18.372 litres capacity. The De Havilland technicians have taken full advantage of the low frontal area of this unit by evolving a special cooling system wherein air is taken in through orifices in the leading edge and led round the engine (which, except for a controllable flap, is totally enclosed) from the rear. This exclusive British arrangement, apart from being aerodynamically efficient, is particularly advantageous during the running-up period, when air is being fed from an efficient portion of the airscrew.

"Flat" engines (horizontally opposed) are usually considered as liquid-cooled types, although ducted cooling for wing installations may pave the way for air-cooled models. The Potez-Lorraine "flat-twelve" shown at Paris is a courageous attempt at such a unit. The ducted method of cooling, incidentally, may soon be applied to radials. Briefly, it entails the deletion of the cooling gills round the trailing edge of the ring cowl and "ducting" the cooling air through conduits to the trailing edge of the wing where there is a controllable flap. Ultimately, this scheme may be developed according to the ideas of Mr. Meredith, of the R.A.E., who visualises ducted cooling systems functioning as heat engines, the thrust obtained being roughly as the square of the speed.

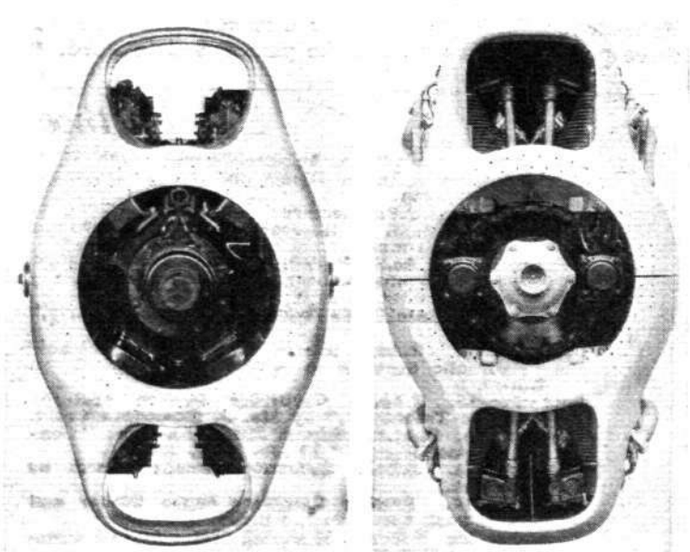
Mr. Fedden visualises utilising the kinetic energy of the gases in a rearward-facing exhaust pipe, which gain, unfortunately, varies only as the machine's speed. Nevertheless, it would be more than sufficient to offset the losses due to change of momentum of the air for carburettor and oil cooling, which varies as the square of the speed, and still leave a balance for effective thrust.

This country is particularly well placed in respect of the smaller types of in-line air-cooled engines, as exemplified by the De Havilland Gipsies, the Cirrus engines and the little Weir. Favourable qualities for private-owner operation are the good forward and downward view permitted from a conventional single-engined tractor installation and the ease of maintenance. Inter-overhaul periods of 750 hours for the D.H. Gipsy Six and of 1,000 hours for the Gipsy Major are indications of the brilliant qualities of such units.

Although the French and Americans have taken to supercharging engines of similar characteristics, British manufacturers have been loath to apply blowers, and, indeed, at the moment there seems to be little call for them. What we have done is to make provision for V.P. airscrews on the D.H. Gipsy Six and Gipsy Major.

On the whole, the response to the demand for an efficient, reliable and cheap unit for ultra-light machines has been somewhat discouraging, although there are one or two units which display some commendable features.

The technique of liquid cooling has probably been



The Napier Dagger (left) and the Rapier with their nose cowls, which are regarded as an integral part of the power unit.